juice which holds them in suspension or solution. The moment the juice is expelled from the. cells of the canes chemical inversion commences, and the sooner it is stopped the better. This is effected by the addition of lime to neutralize the free acid. As cold juice has a greater affinity for lime than hot juice, it is best to treat the juice with lime when cold. This is easily done in. liming or measuring tanks of known capacity, into which the juice is run from the mill. The requisite amount of milk of lime set up at 10° Beaumé is then added. Cream of lime of 17° Beaumé is sometimes used, but the weaker solution is preferable, since the proper proportion is more easily adjusted. In Demerara and other places the juice is then heated under pressure up to 220° F. to 250° F. for a few moments, on its way to a steam and juice separator, where the steam due. to the superheated juice flashes off, and is either utilized for aiding thc steam supplied to the multiple effect evaporators, or for heating cold juice on its way to the main heater, . or it is allowed to escape into the atmosphere. The boiling juice is run down into subsiding tanks, where it cools, and at the same time the albumen, which has been suddenly coagulated by momentary exposure to high temperature, falls to the bottom of the tank, carrying with it the vegetable and other matters which were in suspension in the juice. After reposing some time, the clear juice is carefully decanted by means of a pipe fixed by a swivel joint to an outlet in the bottom of the tank, the upper end of the pipe being always kept at the surface of the liquor by a float attached to it. Thus clear liquor alone is run off, and the mud and cloudy liquor at the bottom of the tank are left undisturbed, and discharged separately as required.

In Australia a continuous juice separator is generally, used, and preferred to ordinary subsiding or filtering tanks. It is a cylin­drical vessel about 6 ft. deep, fitted with a conical bottom of about the same depth. Such a vessel is conveniently made of a. diameter which will give, the cylindrical portion sufficient capacity to hold the juice expressed from the cane-mill in one hour. The hot liquor is con­ducted downwards in a continuous steady stream by a central pipe to eight horizontal branches, from which it issues into the separator at the level of the junction of the cylindrical and conical portions of the vessel.. Since the specific gravity of hot liquor is less than that, of cold liquor, and since the specific gravity of the scum and particles of solid matter, in suspension, varies so slightly with the temperature that practically it remains constant, the hot liquor rises to the top of. the vessel, and the scums and particles of solid matter in suspension separate themselves from it and fall to the bottom. By the mode of admission the hot. liquor at its entry is distributed over a large area relatively to its volume, and while this is necessarily effected with but little disturbance to the contents of the. vessel, a very slow, velocity is ensured for the current of ascending juice. In a continuous separator of which the cylindrical portion measures 13. ft. in diameter and 6 ft. deep (a suitable size for treating a juice supply of 4000 to 4500 gallons per hour), the upward current will have a velocity of about 1 inch per minute, and it is found that all the impurities have thus ample time to separate themselves. The clear juice when it arrives at the top of the separator flows slowly over the level edges of *µ* cross canal and passes in a continuous stream to the service tanks of the evapo­rators or vacuum pan. The sloping sides of the conical bottom can be freed from the coating of scum which forms upon them every two or three hours by two rotatory scrapers, formed of L-irons, which can be slowly turned by an attendant by means of a central shaft provided with a suitable handle. The scums then settle down to the bottom of the cone, whence they are run off to the scum tank. Every twenty-four hours or so the flow of juice may be conveniently stopped, and, after all the impurities have subsided, the superincumbent clear liquor may be decanted by a cock placed at the side of the cone for the purpose, and the vessel may be washed out. These separators are carefully protected by non-conducting cement and wood lagging, and are closed at the top to prevent loss of heat; and they will run for many hours without requiring to be changed, the duration of the run depending on the quality of the liquor treated and amount of impurities therein. Smaller separators of the same construction are used for the treatment of syrup.

In Cuba, Martinique, Peru and elsewhere the old-fashioned double-bottomed defecator is. used, into which the juice is run direct, and there limed and heated. This defecator is made with a hemispherical copper bottom, placed in an outer cast-iron casing., which forms a steam jacket, and is fitted with a cylindrical curb or breast above the bottom. If double-bottomed defecators are used in sufficient number to allow an hour and a half to two hours for making each defecation, and if they are of a size which permits any one *of* them to be filled up by the cane-mill with juice in ten to twelve minutes, they will make as perfect a defecation as is obtainable by any known system; but their employment involves the expenditure of much high-pressure steam (as exhaust steam will not heat the juice quickly enough through the small surface of the hemispherical inner bottom), and also the use of filter presses for treating the scums. A great deal of skilled superintendence is also required, and first cost is comparatively large. When a sufficient number are not available for a two hours’ defecation, it is the practice in some factories to skim off the scums that rise to the top, and then boil up the juice for a few minutes and skim again, and, after repeating the operation once or twice, to run off the juice to separators or subsiders of any of the kinds previously described. In Java and Mauritius, where very clean canes arc grown, double-bottomed defecators are generally used, and to them, perhaps as much as to the quality of the canes, may be attributed the very, strong, fine sugars made in those islands. They are also employed in. Egypt, being remnants of the plant used in the days when the juice passed through bone-black before going to the evaporators.

A modification of the system of double-bottom, defecators has lately been introduced with considerable success in San Domingo and in Cuba, by which a continuous and steady discharge of clear defecated juice is obtained on the one hand, and on the other a comparatively hard dry cake of scum or cachaza, and without the use of filter presses.. These results are brought about by adding to the cold juice as it comes from the mill the proper proportion of milk of lime set up at 8o B., and then delivering the limed juice in a constant steady stream as near the bottom of the defecator as possible; it is thus brought into immediate contact with the heating surface and heated once for all before it ascends, with the result of avoid­ing the disturbance caused in the ordinary defecator, by pouring cold juice from above on to the surface of the heated juice, and so establishing down-currents of cold juice and up-currents.of hot juice. In the centre of the defecator an open-topped cylindrical vessel is placed, with its bottom about. 6 in. above the bottom of the defecator and its top about 12 in. below the top of the defecator. In this vessel is placed the short leg of a draw-off siphon, reaching to nearly the bottom. The action of the moderate heat, 210o F., on the limed juice causes the albumen in it to coagulate; this rising to the surface collects the cachazas, which form and float, thereon. The clear juice in the meantime flows over the edge of the cylindri­cal vessel without disturbance and finds its way out by the short leg of the siphon, and so passes to the canal for collecting the defecated juice.. The admission of steam must be regulated with the greatest nicety, so as to maintain an equable temperature, 208° to 210° F., hot enough to act upon the albumen and yet not enough to cause ebullition or disturbance in the juice, and so prevent a proper separation of the cachazas. This is attained by the aid of a copper pipe, 4 in. in diameter, which follows the curve of the hemispherical bottom, and is fitted from one side to the other of the defecator; one end is entirely closed, and the other is connected by a small, pipe to a shallow circular vessel outside the defecator, covered with an india-rubber diaphragm, to the centre of which is attached a light rod actuating a steam throttle-valve, and capable of being adjusted as to length, &c. The copper pipe and circular vessel are filled with cold water, which on becoming heated by the sur­rounding juice expands, and so forces up the india-rubber diaphragm and shuts off the steam. By adjusting the length of the connecting rod and the amount of water in the vessel, the amount of steam admitted can be regulated to a nicety. To make this apparatus more perfectly automatic, an arrangement for continually adding to and mixing with the juice the proper proportion of milk of lime has been adapted to it; and although it may be objected that once the. proportion has been determined no allowance is made for the variation in the quality of the juice coming from the mill owing to the variations that may occur in the canes fed into the mills, it is obviously as easy to vary the proportion with the automatic arrangement from time to time as it is to vary in each separate direction, if the man in charge will take the trouble to do so, which he very seldom does with the ordinary defecators, satisfying himself with testing the juice once or twice in a watch. The scums forming on the top of the continuous defecator become so hard and dry that they have to be removed from time to time with a specially constructed instrument like a flat spade with three flat prongs in front. These scums are not worth passing through the filter presses, and are sent to the fields direct as manure.

The scums separated from the juice by ordinary defecation entangle and carry away with them a certain amount of the juice with its contained, saccharine. In some factories they are collected in suitable tanks, and steam is blown into them, which further coagulates the albuminous par­ticles. These in their upward passage to the top, where they float, free themselves from the juice, which they leave below them comparatively clear. The juice is then drawn off and pumped up to one of the double-bottomed defecators and redefecated, or, where juice-heaters have been used instead of defecators, the scums from the separators or subsiders are heated and forced through filter presses, the juice expressed going to the evaporators and the scum cakes formed in the filter presses to the fields as manure.

In diffusion plants the milk of lime is added, in proper propor­tion, in the cells of the diffusion battery, and the chips or slices themselves act as a mechanical filter for the juice; while in the Sandwich Islands coral-sand. filters have been employed for some years, in addition to the chips, to free the juice from impurities held in mechanical suspension. In Germany very similar filters have also, been used, pearl-quartz gravel taking the place of coral sand, which it closely resembles. In Mexico filters filled with dry